ONE-PART DENTAL IMPLANT

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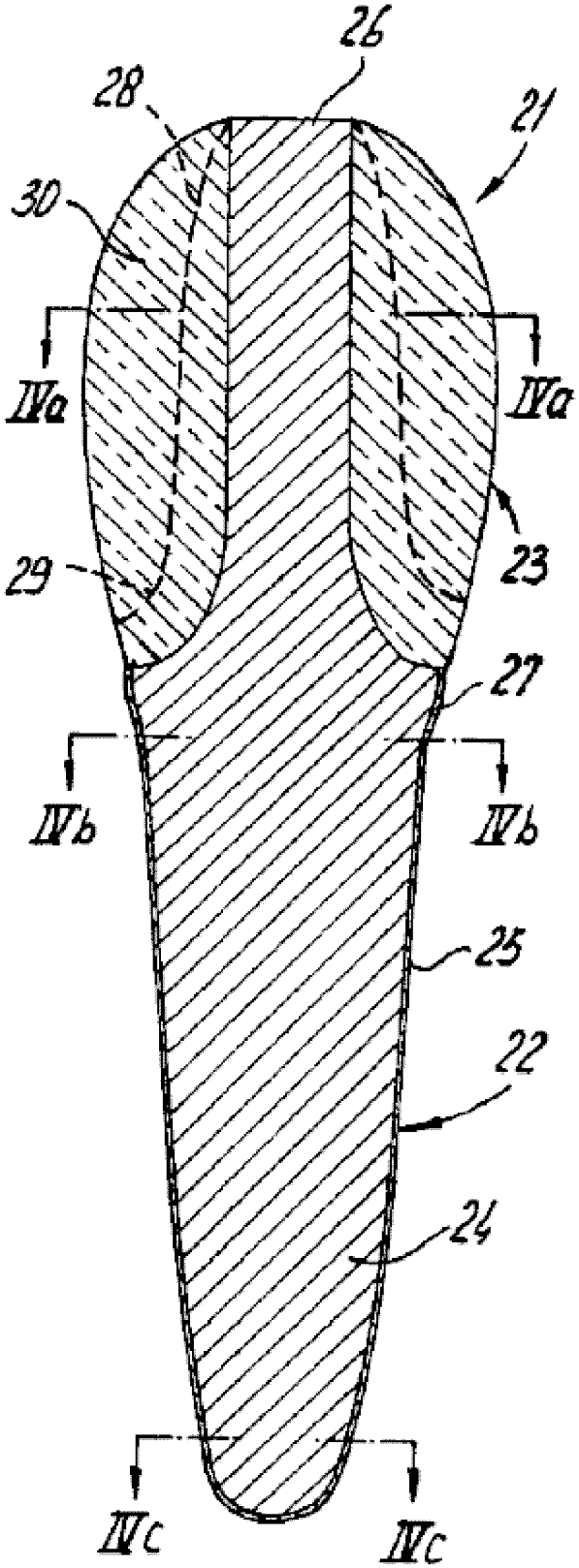
Abstract of **WO0134056**

The invention relates to an implant, coloured to match the teeth, for fitting in a jaw, having an insertion component which can be fitted in the jawbone and having a support component for fixing a dental prosthesis. The support component is intended to protrude beyond the jawbone when the insertion component is in the implanted position. The support component, or at least an external peripheral portion thereof, is made of a ceramic material of a thickness such that the ceramic material can be partially removed in order to adapt the shape of the support component. During this operation it is possible, in particular, for a shoulder for supporting the dental prosthesis to be formed, which shoulder narrows the support component and follows the edge of the jawbone surrounding the implant.



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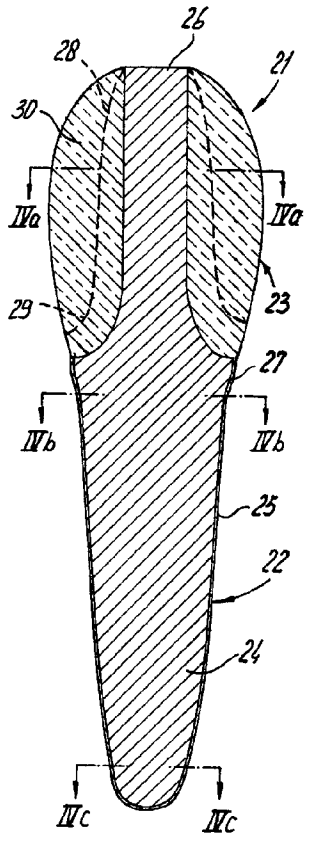


(57) Abstract: The invention relates to an implant, coloured to match the teeth, for fitting in a jaw, having an insertion component which can be fitted in the jawbone and having a support component for fixing a dental prosthesis. The support component is intended to protrude beyond the jawbone when the insertion component is in the implanted position. The support component, or at least an external peripheral portion thereof, is made of a ceramic material of a thickness such that the ceramic material can be partially removed in order to adapt the shape of the support component. During this operation it is possible, in particular, for a shoulder for supporting the dental prosthesis to be formed, which shoulder narrows the support component and follows the edge of the jawbone surrounding the implant.

WO 01/34056 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

One-part dental implant

One-part dental implant for fitting in a jaw, consisting of an insertion component which can be fitted in the jawbone and a support component, that in the implanted position protrudes beyond the jawbone, for fixing a dental prosthesis, the support component and insertion component lying in the extension of one another and abutting one another.

Implants are used in dentistry, a cavity being drilled in the jawbone into which the implant is screwed tight or is pressed in. A dental prosthesis or crown is fitted on that part of the implant which protrudes beyond the gingiva. A disadvantage which arises with known implants is that a completely natural imitation of an original tooth is not possible with these. Known implants are usually cylindrical so that their shape is adapted in the optimum manner to the cylindrical cavities. However, so-called "stress shielding" usually arises as a result, which means that the bone present is resorbed in locations where there is no stress on the implant.

The contour of the neck of the tooth of known implants is also usually cylindrical, so that the interdental gingiva, or the papillae, does/do not assume a natural garland shape or does/do so only with difficulty. Furthermore, the metal of known implants can show through the gingiva so that a local (grey) discoloration is produced.

The procedure when fitting a dental implant is generally as follows:

The old tooth element is removed and/or the jaw is built up and the implant is fitted, usually punched, into the natural or built-up alveolus. An impression of the teeth, or at least of the relevant portion of the jaw, is then taken, on the basis of which a dental technician makes a customised crown. Some time after, usually a few weeks after, the implant has been fitted in the jaw, this customised crown is then fixed on the support component of the implant. With this procedure the implant is a standard element, the shape of which is, for factory reasons, completely predetermined.

A one-part implant of the type indicated in the preamble is disclosed in US-A 4 199 864. In fact, two types of one-part implant are disclosed in this publication. The first type, as is shown, for example, in Fig. 1 of US-A 4 199 864, is a one-part implant having an insertion component, that replaces the natural root, with an artificial crown, formed as an integral whole with the insertion component, directly on top. However, this type of one-part

implant does not closely resemble the type of one-part implant to which the present invention relates. The present invention relates far more to the second type of one-part implant shown in US-A 4 199 864. With regard to this second type of one-part implant, reference can be made to, for example, Figs 3 and 4 of the cited publication. In this second type of one-part implant, the artificial crown is a separate component that is fitted on the support end of the one-part implant after the latter has been fitted. The one-part implant itself consists of an insertion component which can be fitted in the jawbone and a support component, that in the implanted position protrudes beyond the jawbone, on which the dental prosthesis, the so-called artificial crown, is fitted. The support component and the insertion component lie in the extension of one another and abut one another. The starting point in US-A 4 199 864 is that an attempt is made as far as possible to obtain an exact replica of the natural tooth element. To this end the original tooth element is taken as the starting point. This original tooth element is used to make a mould, the shape of the mould cavity of which corresponds to that of the original tooth element. As described in column 9, lines 51-60, a hard plastic pin is inserted in the mould cavity and the remainder of the mould cavity is filled with a mixture of plastic and leachable crystals. The top of the pin ultimately forms the so-called support component and the bottom of the pin forms the reinforcement of the root component, also referred to as the insertion component. In this way a one-part implant is obtained that can be fitted in the jaw as an integral whole. This is in contrast to implants where first the so-called insertion component is fitted in the jaw and then the so-called support component is fitted thereon, in order then to fit the crown on the support component. A disadvantage of the implant according to US-A 4 199 864 is that in practice it is far from always easily possible to fit the "exact replica" in the jaw in accordance with the original tooth element. This can then lead to problems when fixing the crown on the support component of the implant in a subsequent step. It is true that the crown can be made such that it fits exactly, but the implant fitted in the jaw will be visible at the bottom of the crown as a consequence of incorrect abutment with the gingiva, which the patient finds unpleasant.

Implants of the two-part type, that is to say with which the insertion component and support component are joined to one another, for example by a screw connection, after fitting the insertion component in the jaw are, for example, disclosed in USA 5 695 337 and WO 97/30654. Both publications disclose that the support component can be made of zirconium oxide. WO 97/30654 states that an advantage of a support component made of zirconium oxide is that this can be individually ground in a dental laboratory, or its shape can

be matched to the patient by means of grinding operations. According to USA 5 695 337 it is possible to adjust the insertion component to size in the mouth, that is to say after fitting the insertion component. The disadvantage of two-part implants is, however, that the so-called insertion component first has to be fitted in the jaw and the so-called support component then has to be fitted thereon, for example by means of a screw connection. This involves additional operations and renders such implants relatively vulnerable to breakage. The support component and the insertion component can break apart.

The aim of the present invention is to provide a one-part implant having a support component that protrudes beyond the jawbone for fixing a dental prosthesis, a so-called crown, it being possible to correct the shape of the support component in order, for example, to support the gingiva or at least to provide a very accurate approximation to the natural shapes.

The Applicant has come to the insight that said aim can be achieved if the support component, or at least an external peripheral portion thereof, is made of a ceramic material of a thickness such that said ceramic material can be partially removed in order to adapt the shape of the support component. Previously the opinion has been that when a ceramic material is used in the support component this support component has to be a separate component that is fitted on the so-called insertion component later on. The reason for this is that otherwise the so-called support component would splinter off or would otherwise become damaged or broken when driving the insertion component into the jawbone – during which operation forces have to be exerted on the support component in the case of a one-part construction. The Applicant has found that a ceramic material made of zirconium oxide, or at least based on zirconium oxide, is outstandingly able to withstand the forces exerted when driving the support component into the jawbone, even if the entire one-part implant has been made from essentially solid zirconium oxide, or at least a material based on zirconium oxide. However, other ceramic materials are also found to be very suitable, it optionally being possible to provide a core, for example a metal core, in the implant, which core extends to the top of the support component in order to absorb the forces exerted on the support component when driving in.

According to the present invention, the support component that in the implanted position protrudes beyond the jawbone, or at least the ceramic peripheral portion of said support component, can be matched, for example by grinding, to the shape of the dental prosthesis, even down to below the gingival margin. Consequently, a very accurate

approximation of the natural shape can be obtained. The arch or garland shape of the gingiva can be accurately approximated since the ceramic material of the support component can be filed away or ground in such a way that said support component abuts to just beyond the top edge of the jawbone. It is pointed out that according to the present invention it is conceivable for the entire implant, that is to say both the support component and the insertion component, to be made of a ceramic material, optionally completely or partially covered with a coating.

According to a preferred embodiment of the implant according to the invention, in the implanted position the ceramic, external peripheral portion extends from the jawbone to beyond the jawbone in order to be able to form a shoulder in the support component, to support the dental prosthesis, by partially removing the ceramic material, which shoulder, in the implanted state, follows the shape of the top edge of the jawbone running around the implant and abuts said top edge or is located just above it. By removing the ceramic material in order to form a shoulder for supporting the dental prosthesis, the support component is adapted to the bone line of the jawbone, as a result of which, in contrast to implants which function with screws or abutments, a natural gingiva line is obtained. After fitting the dental prosthesis on the shoulder following the bone line, the implant is then, moreover, entirely hidden from sight by the gingiva and the prosthesis.

So that the implant can be made completely to size and in particular can be accurately matched to the shape of the bone line of the jawbone, it is advantageous according to the invention if the ceramic material is a material that can be ground or filed when the implant is in the implanted position. In this way the shape of the implant can be accurately adapted using filing and grinding tools conventionally used by a dentist. Compared with adapting the shape of an implant in advance, this has the advantage that in this way it is also possible to compensate for inaccuracies in fitting the implant. After all, it is conceivable that the implant cannot be inserted quite as deeply into the jawbone as was envisaged when adapting the shape in advance. Incidentally, according to the invention it is also not precluded that the shape of the implant is partially or completely adapted prior to implantation. This can then optionally be carried out in a dental laboratory. However, even if the shape of the implant has already been adapted prior to implantation, it is possible even after implantation to adapt the shape of the implant according to the invention even more accurately, or further to machine the shape.

In order to provide the implant with an appearance that is as natural as possible and, amongst other things, to prevent darker portions showing through, it is advantageous

according to the invention if the ceramic material, preferably the entire peripheral surface of the support component, is of a colour that matches the teeth, such as whitish or yellowish.

In order to prevent "stress shielding" it is advantageous according to the invention if the insertion component narrows, in particular tapers, towards the free end thereof.

So as to have to remove as little ceramic material as possible prior to implantation or after implantation when adapting the shape of the support component, it is advantageous according to the invention if the support component narrows, in particular tapers, towards the free end thereof.

So that the transition from the insertion component to the support component, which transition will be approximately at the level of the jawbone, can be visually detected during implantation without having to provide markers, it is advantageous according to the invention if the implant has its largest cross-section, or cross-sectional surface area, in the transition region from the insertion component to the support component. In this context it is advantageous, in order to obtain good transmission of pressure and distribution of pressure to the jawbone, if said transition region is provided with a protuberance, preferably a coving, extending in the peripheral direction of the implant.

According to advantageous embodiments, the implant according to the invention can have one or more of the following dimensions:

- the cross-section in the transition region is at least approximately 3 mm; and/or
- the length of the insertion component is at least approximately 10 mm, such as approximately 12 mm or more; and/or
- the length of the support component is at least approximately 5 mm, such as approximately 6 mm or more.

According to an advantageous embodiment of the invention, the ceramic material will be zirconium oxide, or at least a ceramic material based on zirconium oxide. Zirconium oxide is naturally glassy, but can easily be coloured to match the teeth by using a colorant, which is to be preferred according to the invention. Zirconium oxide is also a ceramic material that is very suitable for punching into the jawbone since it does not readily tend to splinter and crack.

According to further advantageous embodiments of the invention:

- the support component is essentially made completely of ceramic material and/or
- the transition region from the insertion component to the support component, at least at its outer periphery, is made of said ceramic material; and/or

- the insertion component is essentially made completely of said ceramic material.

Preferably essentially the entire implant will be made of said ceramic material, in which case zirconium oxide or a material based on zirconium oxide is particularly suitable.

It is pointed out that here "essentially made completely" is not understood to mean "made exclusively of". "Essentially made completely" does not preclude the relevant portion of the implant also being covered by a layer, such as, for example, a coating. In particular in the case of an insertion component essentially made completely of ceramic material, the present invention provides for the possibility of this insertion component also being covered by a coating, in particular a coating that promotes bone intergrowth. Such a coating can itself be a ceramic material, but can also be a different material. In this context consideration can be given to, for example, Al_2O_3 or hydroxyapatite or some other material.

According to a particular embodiment according to the invention, the insertion component is at least triangular, such as, for example, rectangular or pentangular.

Preferably, the cross-section or radial section of the insertion component of the implant is oval. As a result, very natural contact between the gingiva and the implant is obtained, in contrast to known cylindrical implants where the gingiva has the tendency to stretch tightly around the implant so that the papillae widen. Instead of an oval cross-section, it is, however, also possible, for example for molars, to choose a triangular, trapezoid or rectangular cross-section for the insertion component.

The present invention further also relates to a method for fitting an implant in a jaw, said implant having an insertion component, to be fitted in the jawbone, and a support component provided thereon which is intended to protrude from the jawbone in the implanted position, at least part of the peripheral surface of the support component being made of a material that can be ground, in particular a ceramic material that can be ground, and the method comprising the following steps:

- fitting the insertion component in the jaw, in particular in an alveolus, that can be either natural or artificial;
- grinding away peripheral material from a support component, when the latter has been implanted in the jaw, in order to adapt the shape thereof and
- fitting a dental prosthesis, in particular a crown, on the support component.

According to an advantageous embodiment of the method according to the invention, grinding peripheral material away from the support component is carried out in such a way

that a shoulder for supporting the dental prosthesis is formed at the level of the top edge of the jawbone surrounding the implant, which shoulder narrows the support component and follows said top edge.

The implant according to the present invention can be fitted immediately after removal of a natural tooth. In situations where the natural dentition has long since disappeared, it is necessary to build up the jaw beforehand and to fit the implant in a second stage.

The present invention will be explained in more detail below with reference to illustrative embodiments shown in the drawings. In the drawings:

Fig. 1 shows a longitudinal section of an implant according to a first preferred embodiment of the invention;

Figs 2a, 2b and 2c show, respectively, sections along the lines IIa, IIb and IIc in Fig. 1;

Fig. 3 shows a longitudinal section of an implant according to a second embodiment of the present invention;

Figs 4a, 4b and 4c show, respectively, sections along the lines IVa, IVb and IVc in Fig. 3;

Fig. 5 and Fig. 6 show, respectively, a lateral longitudinal section and a frontal longitudinal section of an implant according to the invention that has been fitted in the jaw and provided with an artificial tooth; and

Fig. 7, Fig. 8, Fig. 9, Fig. 10 and Fig. 11 respectively show, diagrammatically, a premolar implant, a lower incisor implant, a molar TJ (top jaw) implant, a molar BJ (bottom jaw) implant and a central front implant, all in accordance with the present invention, where:

- the a figures each show a longitudinal view;
- the b figures each show a cross-section of the support component;
- the c figures each show a cross-section of the transition region between support component and insertion component and
- the d figures each show a cross-section of the insertion component.

Figs 1 and 2 show an implant 1 according to a first embodiment of the present invention, having an insertion component 2 that can be inserted in the jaw and having a support component 3 that protrudes from the jawbone and can even protrude beyond the gingiva and on which an artificial tooth can be fixed. The implant 1 is essentially made

completely of a ceramic material, in particular a zirconium oxide that has been coloured to match the colour of the teeth. The external surface of the insertion component 2 is covered by a coating or top layer 5 of, for example, Al_2O_3, but this can also be a different material, for example a non-ceramic material. The top of the support component 3 is indicated by 6. When punching, this top portion 6 forms an impact surface for the punching tool. Partly for this reason, the cross-sectional dimension of said top surface 6 will be at least 2 mm, but preferably at least 3 mm. The transition region between the insertion component 2 and the support component 3 is marked by a peripheral rim 12 or peripheral protuberance 12. In the implanted position this peripheral protuberance 12 ensures good transmission of pressure and good distribution of pressure to the jawbone.

As can be seen from Figures 2a to 2c, the radial cross-section of the support component 3 is approximately circular, whilst the cross-section of the insertion component 2 is oval.

The implant according to the present invention can be fitted in an existing cavity, also termed an alveolus, in the jaw by punching, using very simple tools. As a result of the oval and tapering shape of the insertion component 2, a good and naturally shaped binding fit in the jawbone is obtained.

Figs 5 and 6 show, respectively, a lateral longitudinal section and a frontal longitudinal section of a jaw 7 which is covered by gingiva or gum 8. An artificial tooth or crown 9 has been fitted on the support component 3 of the implant 1. The ceramic material has been filed off the support component 3 along a contour 10 for the artificial tooth 9. A shoulder 13 adjoining the bone line of the jaw 7 has also been formed in the ceramic material of the support component 3. Part of the gingiva bears against this shoulder 13 and part against the protuberance 12. The shoulder 13 follows the contour of the crown line 11 "which is located between the gingival line 11 and bone line 11" of the jawbone. As a result the gingiva assumes its natural garland shape along the shoulder 13 of the neck of the tooth, as is shown by the gingival line 11. In the transition region between the support component and the insertion component the periphery of the implant bends outwards against the jawbone of the jaw 7 to provide the "stress shielding" effect.

Figs 3 and 4 show an implant 21 according to the present invention having an insertion component 22 that can be inserted in the jaw and having a support component 23 that protrudes from the jaw beyond the gingiva and on which an artificial tooth (for example artificial tooth 9 in Figs 5 and 6) can be fixed. The implant 21 consists of a metal core 24,

for example made of titanium. Around the core 24, or at least the insertion component 22, there is a ceramic top layer 25 of, for example, Al_2O_3. However, this can also be zirconium oxide, ZrO, or hydroxyapatite or some other material.

The core 24 of the implant 21 extends as far as the top extremity 26 of the implant 21. At the location of the support component 23, the diameter of the core 24 is 2 mm. The dimension of the core 24 at the location of the insertion component 22 is between 1.5 and 4 mm. The ceramic material 30, also referred to as the 'top layer', has a thickness of 1.5 mm for the support component. The thickness of the top layer 25 is approximately 0.5 mm for the insertion component 22. The ceramic material 30 can be, for example, zirconium oxide, ZrO, or aluminium oxide, Al_2O_3.

As can be seen from Figures 4a to 4c, the radial cross-section of the support component 23 is virtually circular, whilst the cross-section of the insertion component 22 is oval.

The implant 21 according to the present invention can also be fitted in an existing cavity, alveolus, in the jaw by punching, using very simple tools. As a result of the oval and tapering shape of the insertion component 22, a good and natural binding fit in the jawbone is obtained. The core 24 which at the top 26 of the implant 21 is on the surface forms a surface which can be struck by a mallet with, for example, a rubber head, when inserting the implant. A protuberance 27 has been made at the transition from the insertion component 22 to the support component 23 to provide good transmission of pressure and distribution of pressure to the jawbone.

By, in accordance with a preferred embodiment, not providing the top extremity 26 of the support component 23 with a top layer, the top layer is also not damaged by punching and good transmission of force takes place via the metal core 24, which according to a preferred embodiment is made of titanium.

After the implant 21 has been implanted, part of the ceramic material 30 is ground off the support component 23 in accordance with the contour line 28; this can optionally already partially have taken place prior to implantation. In this way an implant can be obtained which has a shape corresponding to the post-machined implant 1 in Figures 5 and 6. By means of this operation, a shoulder 29 is created on which the crown 9 can bear.

As well as for the implants according to the invention as discussed above, the technique according to the present invention can likewise also be employed for implants for other tooth elements, in particular for molars, the insertion component 2 being formed from several

components having, for example, a triangular, trapezoid or rectangular cross-section.

Figs 7-11 show a longitudinal view and three cross-sectional views of an implant according to the invention for diverse tooth elements. In Figures 7-11 the relationships between the dimensions of the implants are indicated by means of numerical values for the size of the various dimensions. For a medium type these numerical values can be read as millimetres. In the case of, for example, Figure 7 the height of the support component is then 6 mm and the length of the insertion component 14 mm and is, at the location of the transition between support component and insertion component, the cross-section B of an oval shape having a transverse dimension of 4 mm and a longitudinal dimension of 5 mm. All dimensions of the implants in Figs 7-11 can be taken approximately 20% smaller for a small type and approximately 20% larger for a large type.

CLAIMS

1. One-part dental implant for fitting in a jaw, consisting of an insertion component which can be fitted in the jawbone and a support component, that in the implanted position protrudes beyond the jawbone, for fixing a dental prosthesis, the support component and insertion component lying in the extension of one another and abutting one another, characterised in that the support component, or at least an external peripheral portion thereof, is made of a ceramic material of a thickness such that said ceramic material can be partially removed in order to adapt the shape of the support component.

2. One-part implant according to Claim 1, characterised in that the thickness of the ceramic material of the support component, or at least of the external peripheral portion thereof, is such that a shoulder to support the dental prosthesis can be formed herein by partially removing said ceramic material.

3. One-part implant according to Claim 1, characterised in that a shoulder to support the dental prosthesis has been formed in the ceramic material of the support component, in that said shoulder extends around the entire periphery of the support and in that, viewed in the peripheral direction of the support, said shoulder follows the shape of the top edge of the jawbone running around the implant in the implanted position, in order to be able to abut said top edge in the implanted position.

4. One-part implant according to one of the preceding Claims 1-3, characterised in that the ceramic material is a ceramic material that can be ground when the implant is in the implanted position.

5. Implant according to one of the preceding claims, characterised in that the ceramic material is zirconium oxide or at least is based on zirconium oxide.

6. One-part implant according to one of the preceding claims, in particular according to Claim 5, characterised in that essentially the entire implant is made of said ceramic material.

7. Implant according to one of the preceding claims, in particular Claim 6, characterised in

that the implant, or at least the insertion component, is covered by a coating, such as a coating that promotes bone intergrowth.

8. Implant according to one of the preceding claims, characterised in that the ceramic material, preferably the entire peripheral surface of the support component, is of a colour that matches the teeth, such as whitish or yellowish

9. One-part implant according to one of the preceding claims, characterised in that the insertion component narrows, in particular tapers, towards the free end thereof and in that the support component narrows, in particular tapers, towards the free end thereof.

10. Implant according to one of the preceding claims, characterised in that the implant has its largest cross-section, or cross-sectional surface area, in the transition region from the insertion component to the support component and in that said transition region is preferably provided with a protuberance extending in the peripheral direction of the implant.

11. Implant according to Claim 10, characterised in that the cross-section in the transition region is at least approximately 3 mm.

12. Implant according to one of the preceding claims, characterised in that:

- the length of the insertion component is at least approximately 10 mm, such as approximately 12 mm or more; and/or
- in that the length of the support component is at least approximately 5 mm, such as approximately 6 mm or more.

13. Implant according to one of the preceding claims, characterised in that the insertion component is at least triangular.

14. Implant according to one of the preceding claims, characterised in that the cross-section of the insertion component is oval.

15. One-part implant according to one of the preceding Claims 1-5, characterised in that the implant has a metal core, for example of titanium or a titanium alloy, and a top layer of said

ceramic material around said core, at least at the location of the support component, and in that the thickness of said ceramic material is such that the ceramic material can be removed to adapt the shape, whilst the core remains covered by ceramic material.

16. One-part implant according to Claim 15, characterised in that the core is not provided with said ceramic material and is preferably uncovered at the top free end of the support component.

17. One-part implant according to one of the preceding claims, characterised in that said thickness of said ceramic material is at least 0.7 mm, preferably at least 1 to 1.5 mm.

18. Method for fitting a one-part implant in a jaw, said implant consisting of an insertion component, to be fitted in the jawbone, and a support component provided thereon, which support component is intended to protrude from the jawbone in the implanted position, at least part of the peripheral surface of the support component being made of a material that can be ground, in particular a ceramic material that can be ground, and the method comprising the following steps:

- fitting the implant in the jaw by punching the insertion component into an alveolus, that can be either natural or artificial;
- grinding away peripheral material from the support component, when the latter has been implanted in the jaw, in order to adapt the shape thereof and
- fitting a dental prosthesis, in particular a crown, on the support component.

19. Method according to Claim 18, characterised in that grinding peripheral material away from the support component is carried out in such a way that a shoulder for supporting the dental prosthesis is formed at the level of the top edge of the jawbone surrounding the implant, which shoulder narrows the support component and follows said top edge.

Fig-1

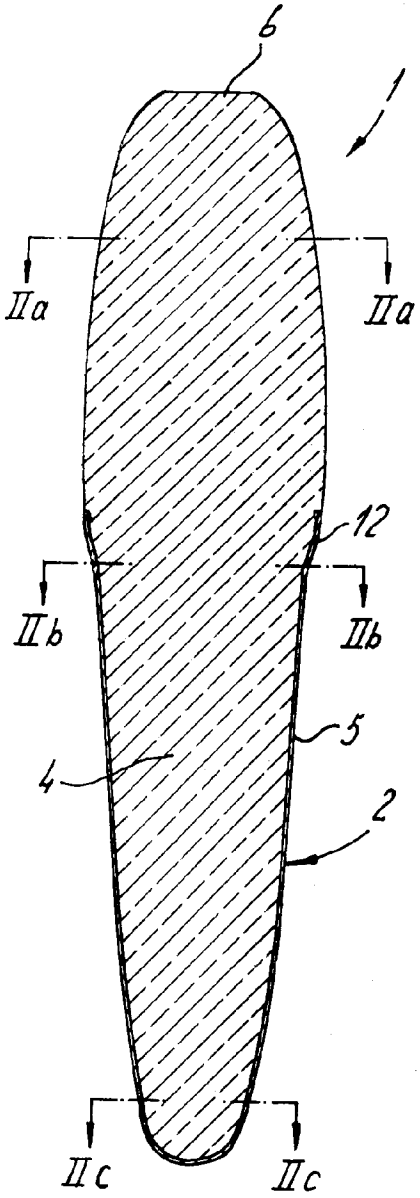


Fig-2a

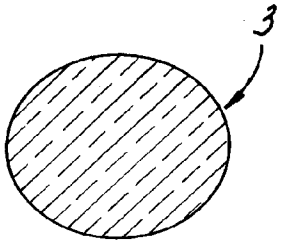


Fig-2b

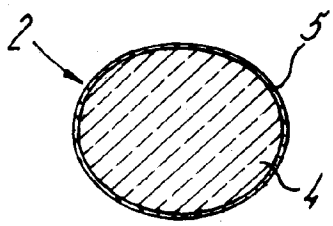


Fig-2c

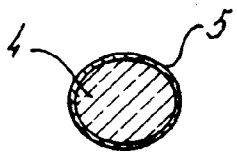


Fig-3

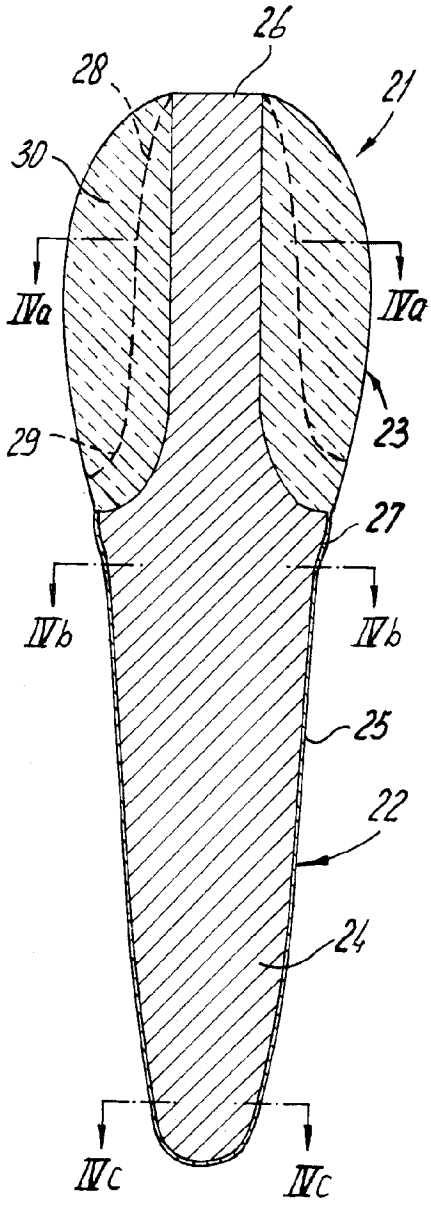


Fig-4a

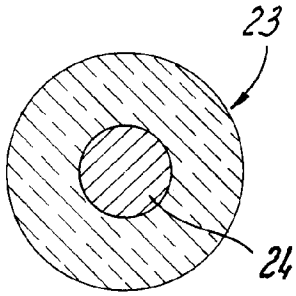


Fig-4b

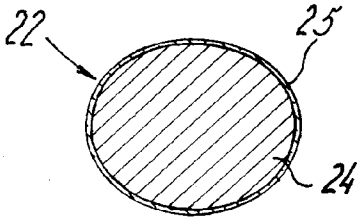


Fig-4c

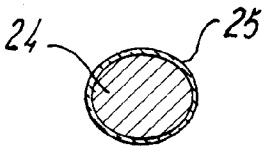


Fig-5

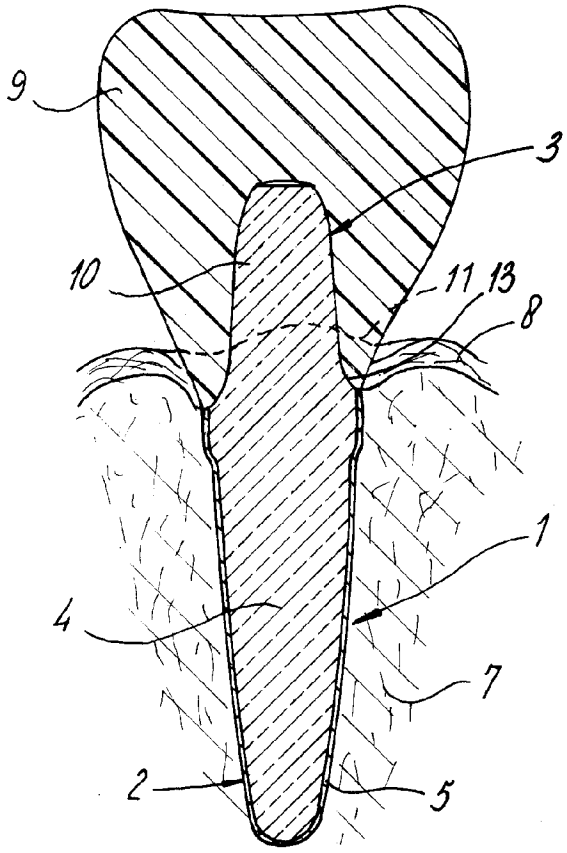


Fig-6

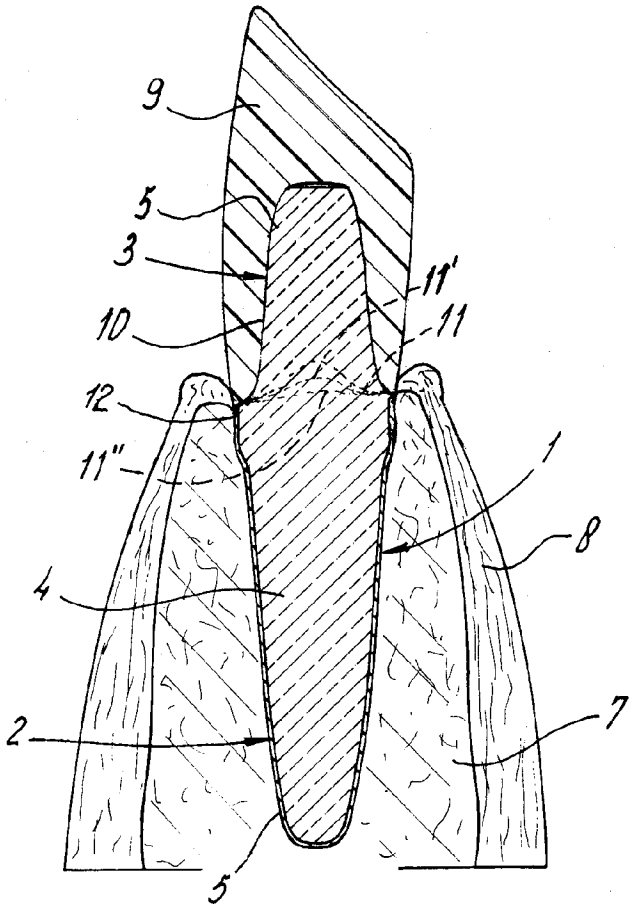


fig - 7

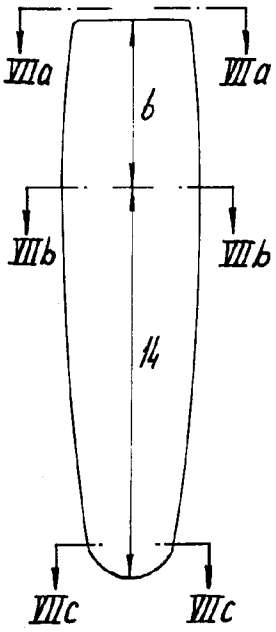


fig - 8

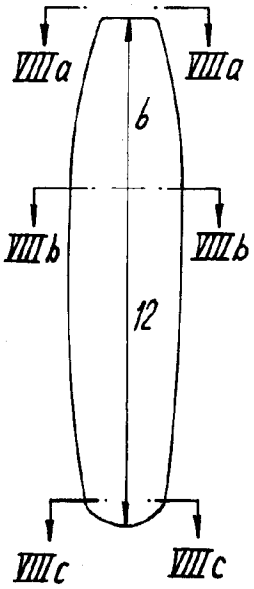


fig - 9

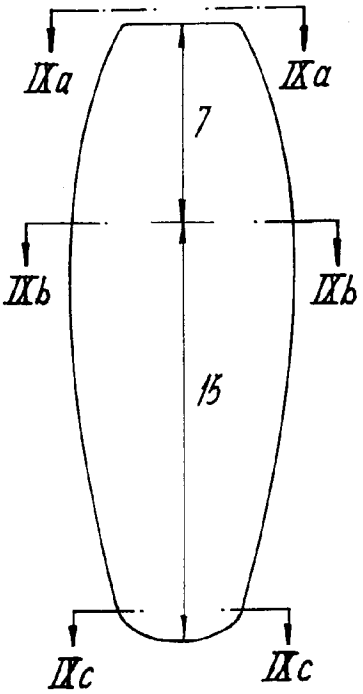


fig - 7a

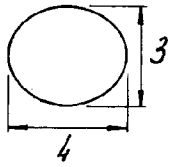


fig - 8a

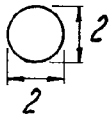


fig - 9a

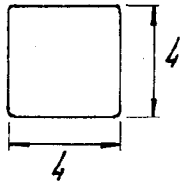


fig - 7b

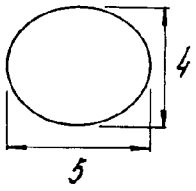


fig - 8b

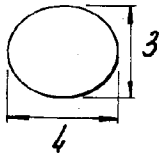
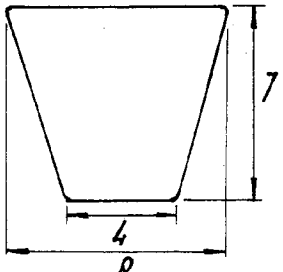


fig - 9b



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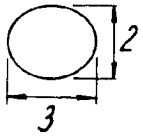

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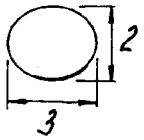

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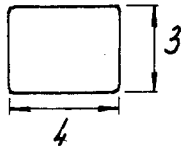
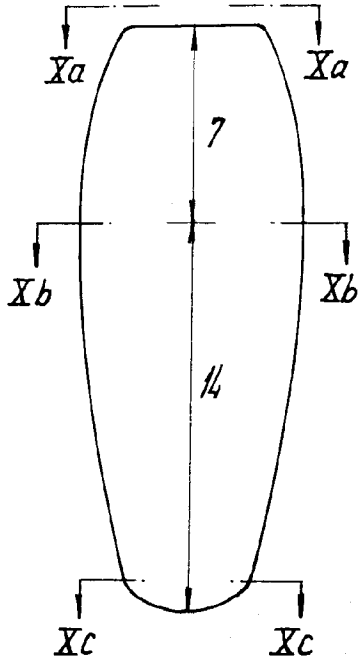


fig - 10



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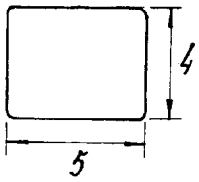
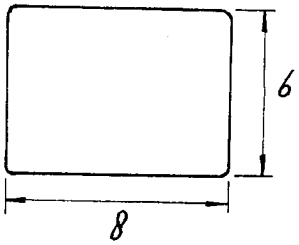


fig - 10b



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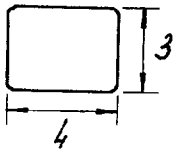


fig - 11

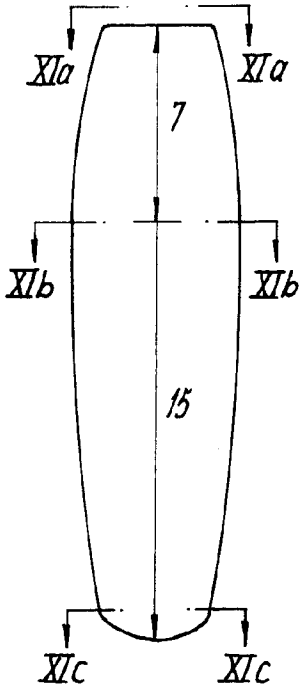


fig - 11a

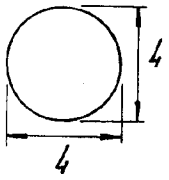
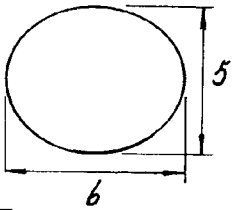


fig - 11b



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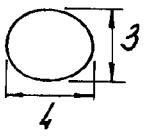

INTERNATIONAL SEARCH REPORT

Ir. ational Application No
PCT/NL 00/00816

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61C8/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 597 091 A (JENAER GLASWERK SCHOTT & GEN) 16 October 1987 (1987-10-16) page 2, line 7-23 page 4, line 2-15 page 5, line 11 -page 6, line 5 page 7, line 10-21 page 9, line 17-32 page 13, line 16 -page 14, line 29	1,2,6, 8-14
Y	US 5 695 337 A (TYSZBLAT SADOUN MICHELE) 9 December 1997 (1997-12-09) cited in the application column 1, line 57 - line 62 column 3, line 34 - line 54 column 4, line 56 - line 67 figures 1-4	1-12,15

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Date of the actual completion of the international search	Date of mailing of the international search report
1 March 2001	08/03/2001

Name and mailing address of the ISA	Authorized officer
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1

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PCT/NL 00/00816

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 411 624 A (OGINO MAKOTO ET AL) 25 October 1983 (1983-10-25) column 1, line 57 -column 2, line 2 column 2, line 48 -column 3, line 32 column 5, line 1 -column 7, line 17 figures 1-12	1-12,15
A	WO 97 30654 A (WOHLWEND ARNOLD) 28 August 1997 (1997-08-28) cited in the application page 5, line 37 -page 7, line 7 page 11, line 30 -page 12, line 2 figures 1-4C	1,2,5
A	US 4 199 864 A (ASHMAN ARTHUR) 29 April 1980 (1980-04-29) cited in the application column 3, line 37 - line 66 column 9, line 9 - line 19; figure 4	1-3,7, 10,15
A	US 5 316 477 A (CALDERON LUIS O) 31 May 1994 (1994-05-31) column 2, line 32 - line 42; figures 1-11A	1-4, 10-12

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In tional Application No
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